

GALAXY FORMATION BY DUST?

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It has been known since the early 1940's^[1] that radiation can cause an instability in the interstellar medium. Absorbing dust particles in an isotropic radiation field shadow each other by a solid angle which is inversely proportional to the square of the distance between the two particles, leading to an inverse-square attractive force – "mock gravity". The effect is largest in an optically thin medium. Recently Hogan and White^[2] (HW, hereafter) proposed that if the pre-galactic universe contained suitable sources of radiation and dust, instability in the dust distribution caused by mock gravity may have led to the formation of galaxies and galaxy clusters. In their picture of a well-coupled dust-gas medium, HW show that mock gravity begins to dominate gravitational instability when the perturbation becomes optically thin, provided that the radiation field at the time is strong enough. The recent rocket observation of the microwave background at submillimeter wavelengths by Matsumoto *et al.*^[3] might be from pre-galactic stars, the consequence of the absorption of ultraviolet radiation by dust, and infrared reemission which is subsequently redshifted. HW's analysis omits radiative drag, incomplete collisional coupling of gas and dust, finite dust albedo, and finite matter pressure. These effects could be important. In a preliminary calculation including them, we have confirmed that mock gravitational instability is effective if there is a strong ultraviolet radiation at the time, but any galaxies that form would be substantially enriched in heavy elements because the contraction of the dust is more rapid than that of the gas. Moreover, since the dust moves with supersonic velocity through the gas soon after the perturbation becomes optically thin, the sputtering of dust particles by gas is significant^[4], so the dust could disappear before the instability develops significantly. We conclude that the mock gravity by dust is not important in galaxy formations. The detailed results of our calculations will be presented elsewhere.

REFERENCES

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